PATENT ABSTRACTS OF JAPAN

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(54) METHOD FOR FORMING ELECTRONIC COMPONENT HAVING PUMP ELECTRODE AND THE BUMP ELECTRODEAND BONDING METHOD FOR THE ELECTRONIC COMPONENT HAVING BUMP ELECTRODE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a specified structure of solder bump electrode difficult to deform.
SOLUTION: The bump electrode comprises a columnar body 29 made of a high m.p. solder (e.g. Pb 95%Sn 5%m.p. about 310-315° C) and surface layer 30a made of a low m.p. (e.g. Pb 37%Sn 63%m.p. about 180-185° C)formed on the entire surface of the body 29 and has an approximately spherical shape on the whole. The electrode body 29 may be made of a metal such as AuCuNietc.haivng a higher m.p. than the solder.

CLAIMS

[Claim(s)]
[Claim 1]Electronic parts which have a projection electrodecomprising:
A main part of a projection electrode which consists said projection electrode of high-melting point solder.
A projection electrode constituting by a projection electrode surface layer which consists of low melting point solder formed in the whole surface of this main part of a projection electrode.

[Claim 2]Electronic parts which have a projection electrode

characterized by the whole shape being almost spherical while shape of said main part of a projection electrode is pillar-shaped and said projection electrode surface layer is formed in the whole surface of this main part of a projection electrode in the invention according to claim 1.
[Claim 3]Electronic parts which have a projection electrodewherein said main part of a projection electrode consists of high-melting point solder which has the melting point of not less than 300 ** in the invention according to claim 1 or 2 and said projection electrode surface layer consists of low melting point solder which has the melting point of 200 ** or less.
[Claim 4]Electronic parts which have a projection electrodecomprising:
A main part of a projection electrode which consists said projection electrode of metal whose melting point is higher than solder.
A projection electrode constituting by a projection electrode surface layer which consists of solder formed in the whole surface of this main part of a projection electrode.

[Claim 5]Electronic parts which have a projection electrode characterized by the whole shape being almost spherical while shape of said main part of a projection electrode is pillar-shaped and said projection electrode surface layer is formed in the whole surface of this main part of a projection electrode in the invention according to claim 4.
[Claim 6]A pillar-shaped main part of a projection electrode which consists of high-melting point solder is formed on a connection pad of electronic partsBy heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of low melting point solder on this main part of a projection electrodeand this projection electrode upper layer fusesand said main part of a projection electrode does not fuseA formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.
[Claim 7]A pillar-shaped main part of a projection electrode which consists of metal whose melting point is higher than solder is formed on a connection pad of electronic partsBy heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of solder on this main part of a projection electrodeand this projection electrode upper layer fusesand said main part of a projection

electrode does not fuseA formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.
[Claim 8]A layer for substrate metal stratification is formed on a connection pad exposed via an opening provided in a protective film which was formed on a substrate of electronic parts and covered on this boardand said protective filmA plating resist layer is formed at not less than about 50 micrometers of thickness on said layer for substrate metal stratification except a portion corresponding to said connection padA pillar-shaped main part of a projection electrode which consists of high-melting point solder is formed in an opening formed in a portion corresponding to said connection pad of this plating resist layerSubsequentlyare on this main part of a projection electrodeand the pillar-shaped projection electrode upper layer which consists of low melting point solder is formed in an opening of said plating resist layerBy heat-treating at temperature which it exfoliatesand said projection electrode upper layer subsequently fuses said plating resist layerand said main part of a projection electrode does not fuseA formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.
[Claim 9]A layer for substrate metal stratification is formed on a connection pad exposed via an opening provided in a protective film which was formed on a substrate of electronic parts and covered on this boardand said protective filmA plating resist layer is formed at not less than about 50 micrometers of thickness on said layer for substrate metal stratification except a portion corresponding to said connection padA pillar-shaped main part of a projection electrode which consists of metal whose melting point is higher than solder is formed in an opening formed in a portion corresponding to said connection pad of this plating resist layerSubsequentlyare on this main part of a projection electrodeand the pillar-shaped projection electrode upper layer which consists of solder is formed in an opening of said plating resist layerBy heat-treating at temperature which it exfoliatesand said projection electrode upper layer subsequently fuses said plating resist layerand said main part of a projection electrode does not fuseA formation method of a projection electrode characterized by making the whole shape almost spherical while forming in the whole surface of said

main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layer.
[Claim 10]Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solderand this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layerA bonding method of electronic parts which have a projection electrode carrying out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of low melting point solder formed in it.
[Claim 11]Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than solderand this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layerA bonding method of electronic parts which have a projection electrode carrying out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of solder formed in it.
[Claim 12]A bonding method of electronic parts which have a projection electrode carrying out bonding of two or more said electronic parts on said 1st substrate in the invention according to claim 10 or 11.
[Claim 13]When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solderand this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layerBy heat-treating at temperature which said projection electrode surface layer fuses firstand said main part of a projection electrode does not fuseA bonding method of electronic parts which have a projection electrode fusing said projection electrode surface layerremoving said electronic parts from on said substrateand carrying out the rebonding of these removed electronic parts on said substrate via said main part of a projection electrode subsequently.
[Claim 14]When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than

solderand this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layerBy heat-treating at temperature which said projection electrode surface layer fuses firstand said main part of a projection electrode does not fuseA bonding method of electronic parts which have a projection electrode fusing said projection electrode surface layerremoving said electronic parts from on said substrateandcarrying out the rebonding of these removed electronic parts on said substrate via said projection electrode surface layer which remains subsequently to the surface of said main part of a projection electrode.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the bonding method of the electronic parts which have the formation method of electronic parts and a projection electrode and projection electrode which have a projection electrode.

[0002]

[Description of the Prior Art]For examplein the mounting technology of the semiconductor chip (electronic parts) called a flip chip manner. The projection electrode which consists of solder formed on the connection pad of a semiconductor chip is laid on the connection pad formed on the circuit boardby heat-treatingreflow (reflow) of the solder is carried out and bonding is performed. Thereforeit is necessary to form in a semiconductor chip the projection electrode which consists of solder.

[0003]Nextit explainsreferring to drawing 9 for the formation method of such a projection electrode. Firstas shown in drawing 9 (A)the connection pad 3 is formed on the insulator layer 2 arranged on the silicon (semiconductor) board 1The protective film 4 is covered by the portion except the center section of the connection pad 3 of the upper surfaceand the center section of the connection pad 3 prepares what was exposed via the opening 5 provided in the protective film 4. Nextas shown in drawing 9 (B)the layer 6 for substrate metal stratification is formed in the whole upper surface. Nextthe plating resist layer 7 is formed in the portion except the portion corresponding to the connection pad 3 of the upper surface of the layer 6 for substrate metal stratification. Thereforethe opening 8 is formed in the plating resist

layer 7 in the portion corresponding to the connection pad 3 in this state. Nextthe projection electrode 9 which becomes the upper surface of the layer 6 for substrate metal stratification in the opening 8 of the plating resist layer 7 from solder is formed by performing electrolytic plating of solder by making the layer 6 for substrate metal stratification into a plating current way. In this casesince he is trying for the thickness of the plating resist layer 7 to become comparatively thin with about 30 micrometerssolder plating deposits isotropic on the plating resist layer 7. For this reasonthe projection electrode 9 in this state serves as mushroom shape. Let shape of the projection electrode 9 be mushroom shape in this stage in order to make into sufficient height the height of the final-shaped projection electrode explained below. Nextthe plating resist layer 7 is exfoliated. Nextif the unnecessary portion of the layer 6 for substrate metal stratification is etched and removed by using the projection electrode 9 as a maskas shown in drawing 9 (C)the substrate metal layer 6a will be formed under the projection electrode 9. Nextif it heat-treats as shown in drawing 9 (D)after the mushroom-shaped projection electrode 9 fusesit will be round with surface tensionand will become almost sphericaland the almost spherical projection electrode 9a will be formed by solidifying in this state.

[0004]Nextdrawing 10 carries out bonding of the semiconductor chip 11 of the above structures for exampleon the two-piece 1st circuit board 12and shows the state where bonding of the 1st circuit board 12 was carried out on the 2nd circuit board 13. In performing such bondingit carries out bonding of the two semiconductor chips 11 on the 1st circuit board 12 via each of that projection electrode 9a first. Nextbonding of the 1st circuit board 12 is carried out on the 2nd circuit board 13 via the projection electrode 14 which consists of solder formed in the undersurface. In this casealthough the 1st circuit board 12 is not illustratedwiring is formed in both sides and it has the structure where these wiring was electrically connected via the through hole conduction part. By thisthe two semiconductor chips 11 will electrically be connected to the 2nd circuit board 13 via the 1st circuit board 12.

[0005]On the other handalthough explained referring to the expedient above figure 10 of explanationwhen bonding of the semiconductor chip 11 is carried out on the circuit board 12this bonding may go wrong. In such a caseby heat-treating firstfuse the projection electrode 9a and the semiconductor chip 11 is removed from on the circuit board 12Subsequentlythe solder which remained on the circuit board 12 is removedandsubsequently bonding (repair) of another semiconductor chip 11

is carried out on the circuit board 12 via the projection electrode 9a. In this caseanother semiconductor chip 11 is used because the projection electrode 9a of the previous semiconductor chip 11 is destroyed and the reuse is impossible.
[0006]
[Problem(s) to be Solved by the Invention]Howeveras shown in drawing 10bonding of the semiconductor chip 11 is carried out for exampleon the two-piece 1st circuit board 12In carrying out bonding of the 1st circuit board 12 on the 2nd circuit board 13Since the projection electrode 9a of the semiconductor chip 11 is also fused when carrying out bonding of the 1st circuit board 12 on the 2nd circuit board 13 via that projection electrode 14the shape of this fused projection electrode 9a may collapse greatly. In such a casethere was a problem that the bonding strength by the projection electrode 9a might fallor a short circuit might occur. On the other handwhen a rebonding was failed and carried out to bondingthe solder which remained on the circuit board 12 had to be removedand there was a problem that the work was troublesome. Since the reuse became impossible by destruction of the projection electrode 9a even if the previous semiconductor chip 11 was an excellent articleit will discard and there was a problem of being noneconomic. The purpose of this invention is to provide the bonding method of the electronic parts which have the formation method of electronic parts and a projection electrode and projection electrode which have a projection electrode in which the shape of the projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily at the time of bonding like the former. Solder can make it possible not to remain easily on a substrate at the time of bonding [like the latter] in which other purposes of this invention areIt is in providing the bonding method of the electronic parts which have the formation method of electronic parts and a projection electrode and projection electrode which have a projection electrode which can carry out the reuse of the electronic parts which consist of a previous semiconductor chip etc.
[0007]
[Means for Solving the Problem]Electronic parts concerning the invention according to claim 1 constitute the projection electrode by main part of a projection electrode which consists of high-melting point solderand a projection electrode surface layer which consists of low melting point solder formed in the whole surface of this main part of a projection electrode. Electronic parts concerning the invention according to claim 4 constitute the projection electrode by main part of a projection electrode which consists of metal whose melting point is higher than

solderand a projection electrode surface layer which consists of solder formed in the whole surface of this main part of a projection electrode. A formation method of a projection electrode concerning the invention according to claim 6A pillar-shaped main part of a projection electrode which consists of high-melting point solder is formed on a connection pad of electronic partsBy heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of low melting point solder on this main part of a projection electrodeand this projection electrode upper layer fusesand said main part of a projection electrode does not fuseWhile forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layerit is made to make the whole shape almost spherical. A formation method of a projection electrode concerning the invention according to claim 7A pillar-shaped main part of a projection electrode which consists of metal whose melting point is higher than solder is formed on a connection pad of electronic partsBy heat-treating at temperature which forms the pillar-shaped projection electrode upper layer which consists of solder on this main part of a projection electrodeand this projection electrode upper layer fusesand said main part of a projection electrode does not fuseWhile forming in the whole surface of said main part of a projection electrode a projection electrode surface layer which consists of said projection electrode upper layerit is made to make the whole shape almost spherical. A bonding method concerning the invention according to claim 10Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solderand this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layerIt is made to carry out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of low melting point solder formed in it. A bonding method concerning the invention according to claim 11Bonding of the electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than solderand this main part of a projection electrode is carried out on the 1st substrate via said projection electrode surface layerIt is made to carry out bonding of this 1st substrate on the 2nd substrate via a projection electrode which consists of solder formed in

it. A bonding method concerning the invention according to claim 13When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of low melting point solder formed in the whole surface of a main part of a projection electrode which consists of high-melting point solderand this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layerBy heat-treating at temperature which said projection electrode surface layer fuses firstand said main part of a projection electrode does not fuseSaid projection electrode surface layer is fusedsaid electronic parts are removed from on said substrateandsubsequently it is made to carry out the rebonding of these removed electronic parts on said substrate via said main part of a projection electrode. A bonding method concerning the invention according to claim 14When electronic parts which have a projection electrode which consists of a projection electrode surface layer which consists of solder formed in the whole surface of a main part of a projection electrode which consists of metal whose melting point is higher than solderand this main part of a projection electrode redo bonding of that by which bonding was carried out on a substrate via said projection electrode surface layerBy heat-treating at temperature which said projection electrode surface layer fuses firstand said main part of a projection electrode does not fuseSaid projection electrode surface layer is fusedsaid electronic parts are removed from on said substrateandsubsequently to the surface of said main part of a projection electrodeit is made to carry out the rebonding of these removed electronic parts on said substrate via said projection electrode surface layer which remains.

[0008]

[Function]In an invention given in claims 16and 10when carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of low melting point solder formed in itthe original form will be maintained as it iswithout the main part of a projection electrode which consists of high-melting point solder of electronic parts fusing.

Thereforethe shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily. In an invention given in claims 47and 11when carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of solder formed in itthe original form will be maintained as it iswithout the main part of a projection electrode which consists of metal whose melting point is higher than the solder of electronic parts

fusing.
Thereforethe shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easily.
In an invention given in claims 16and 13. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the low melting point solderit is heat-treating at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of low melting point solder first fusesand consists of high-melting point solder does not fuse.
Thereforethough the main part of a projection electrode which consists of high-melting point solder does not fuse but solder remains on a substrateit is a part of projection electrode surface layer which consists of low melting point soldertherefore solder can make it possible not to remain easily on a substrate.
And since the main part of a projection electrode which consists of high-melting point solder of the removed electronic parts is maintaining the original form as it isthe reuse of the electronic parts which can carry out a rebonding on a substrate via this main part of a projection electrodetherefore consist of a previous semiconductor chip etc. can be carried out. In an invention given in claims 47and 14. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the solderit is heat-treating at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of solder first fusesand consists of metal whose melting point is higher than solder does not fuse.
Thereforethough the main part of a projection electrode which consists of metal whose melting point is higher than solder does not fuse but solder remains on a substrateit is a part of projection electrode surface layer which consists of soldertherefore solder can make it possible not to remain easily on a substrate.
And since the main part of a projection electrode which consists of metal whose melting point is higher than the solder of the removed electronic parts is maintaining the original form as it isThe reuse of the electronic parts which can carry out a rebonding on a substrate via the projection electrode surface layer which remains on the surface of this main part of a projection electrodetherefore consist of a previous semiconductor chip etc. can be carried out.
[0009]
[Example]Drawing 1 (A) - (C) shows each formation process of the

projection electrode in the 1st example of this inventionrespectively. Thenreferring to these figures in orderit combines with that formation method and the structure of the projection electrode of this example is explained.

[0010]Firstas shown in drawing 1 (A)the connection pad 23 which consists of aluminuman aluminum alloyetc. is formed on the insulator layer 22 which consists of silicon oxide etc. which have been arranged on the silicon (semiconductor) board 21The protective film 24 which becomes a portion except the center section of the connection pad 23 of the upper surface from silicon oxidesilicon nitrideetc. is coveredand the center section of the connection pad 23 prepares what was exposed via the opening 25 provided in the protective film 24.

[0011]Nextas shown in drawing 1 (B)the layer 26 for substrate metal stratification is formed in the whole upper surface. This layer 26 for substrate metal stratification is a three-tiered structureand as an exampleIt consists of a layer formed in about 2000-4000A of thickness by vacuum evaporationweld slagetc. using the titanium tungsten (Ti-W) alloy which is a good metallic material of adhesion with aluminum (aluminum) whose 1st layer is a metallic material of the connection pad 23 from the silicon substrate 21 sideIt consists of a layer which is for a two-layer eye to prevent scaling of the 1st layerand is formed in about 5000-10000A of thickness by vacuum evaporationweld slagetc. using copper (Cu)It consists of a layer which is for the 3rd layer to prevent diffusion of solder and is formed in about 1000-2000A of thickness by plating using nickel (nickel).

[0012]Nextthe plating resist layer 27 is formed in the portion except the portion corresponding to the connection pad 23 of the upper surface of the layer 26 for substrate metal stratification comparatively thickly with about 50-150 micrometers of thickness. The opening 28 is formed in the plating resist layer 27 in the portion corresponding to the connection pad 23 in this state. In this caseafter forming the plating resist layer 27 in all the upper surfaces with a spin coatform the opening 28 by a photolithographybut. As conditions for a spin coatwhen the viscosity of plating resist is about 2500-3000 cpIf number of rotations shall be about 500 rpm when number of rotations shall be about 1000 rpmthickness can be about 50-150 micrometers and the viscosity of plating resist is about 1500-2000 cpthickness can be about 50-150 micrometers.

[0013]Nextby performing electrolytic plating of solder by making the layer 26 for substrate metal stratification into a plating current wayThe melting point on the upper surface of the layer 26 for substrate

metal stratification in the opening 28 of the plating resist layer 27 Not less than 300 ** high-melting point solder. The main part 29 of a projection electrode which consists of (for examplePb95%:Sn5% and the melting point of about 310-315 **) is formed in predetermined heightSubsequentlythe melting point forms in the upper surface of the main part 29 of a projection electrode in the opening 28 the projection electrode upper layer 30 which consists of low melting point solder (for examplePb37%:Sn63%the melting point of about 180-185 **) 200 ** or less. In this casesince the main part 29 of a projection electrode and the projection electrode upper layer 30 are formed only in the opening 28 of the plating resist layer 27the shape of the main part 29 of a projection electrode in this state and the projection electrode upper layer 30 becomes pillar-shaped. Nextthe plating resist layer 27 is exfoliated. Nextif the unnecessary portion of the layer 26 for substrate metal stratification is etched and removed by using the projection electrode upper layer 30 and the main part 29 of a projection electrode as a maskas shown in drawing 1 (C)the substrate metal layer 26a will be formed under the main part 29 of a projection electrode. In this waythe projection electrode in this example is formed.

[0014]Nextdrawing 2 carries out bonding of the semiconductor chip 31 of the above structures for exampleon the two-piece 1st circuit board 32and shows the state where bonding of the 1st circuit board 32 was carried out on the 2nd circuit board 33. In this casealthough the 1st circuit board 32 is not illustrated in detailit is the double-side wiring structure electrically connected via the through hole conduction partThe connection pad 34 is formed in a predetermined part on topand the almost spherical projection electrode 35 in which the melting point consists of low melting point solder (for examplePb37%:Sn63%the melting point of about 180-185 **) 200 ** or less is formed in the predetermined part at the bottom. The connection pad 36 is formed in the predetermined part of the upper surface of the 2nd circuit board 33.

[0015]And in performing bondingfirstalignment of each projection electrode upper layer 30 of the two semiconductor chips 31 is carried out on the connection pad 34 of the 1st circuit board 32and it arranges it. Nextat the temperature which low melting point solder fuses and high-melting point solder does not fuse for exampleby solidifyingafter the projection electrode upper layer 30 fuses if it heat-treats at the temperature of about 200-290 **Bonding of the two semiconductor chips 31 is carried out on the 1st circuit board 32 via each of that projection electrode upper layer 30. In this casethe main part 29 of a projection electrode which consists of high-melting point solder will maintain the

original form as it iswithout fusing. On the other handalthough the projection electrode 35 of the 1st circuit board 32 is fusedsince it only merely fuseswhen it solidifiesthe almost spherical original form will be maintained.
[0016]Nextalignment of the projection electrode 35 of the 1st circuit board 32 is carried out on the connection pad 36 of the 2nd circuit board 33and it is arranged. Nextif it heat-treats at the temperature of about 200-290 ** with the temperature which low melting point solder fuses and high-melting point solder does not fusebonding of the 1st circuit board 32 will be carried out on the 2nd circuit board 33 via the projection electrode 35 by solidifyingafter the projection electrode 35 fuses. In this casealthough the projection electrode upper layer 30 of the semiconductor chip 31 is also fusedsince the original form will be maintained as it iswithout the main part 29 of a projection electrode which consists of high-melting point solder fusingthe shape as the whole projection electrode which consists of the main part 29 of a projection electrode and the projection electrode upper layer 30 cannot collapse easily. As a resultthe fall of bonding strength and short circuit resulting from collapse of the shape of a projection electrode can be prevented from generating.
[0017]Nextthe case where a rebonding (repair) is failed and carried out to the bonding to the circuit board 32 top of the semiconductor chip 31 is explained from the original processreferring to the expedient above figure 2 of explanation. Firstalignment of the projection electrode upper layer 30 of the semiconductor chip 31 is carried out on the connection pad 34 of the circuit board 32and it is arranged. Nextif it heat-treats at the temperature of about 200-290 ** with the temperature which low melting point solder fuses and high-melting point solder does not fusebonding of the semiconductor chip 31 will be carried out on the circuit board 32 via the projection electrode upper layer 30 by solidifyingafter the projection electrode upper layer 30 fuses.
[0018]Howeversuppose that this bonding went wrong. Thennextif it heat-treats at the temperature of about 200-290 ** with the temperature which low melting point solder fuses and high-melting point solder does not fusethe projection electrode upper layer 30 will fuse and the semiconductor chip 31 will be removed from on the circuit board 32. In this casesince the main part 29 of a projection electrode does not fuseonly the projection electrode upper layer 30 is destroyedThough solder remains on the connection pad 34 of the circuit board 32it is a part of projection electrode upper layer 30 which consists of low melting point soldertherefore solder can make it possible not to remain

easily on the connection pad 34 of the circuit board 32. Since the main part 29 of a projection electrode which consists of high-melting point solder of the removed semiconductor chip 31 is maintaining the original formthe rebonding through this main part 29 of a projection electrode is possible for it.

[0019]Thennextalignment of the main part 29 of a projection electrode of the removed semiconductor chip 31 is carried out on the connection pad 34 of the circuit board 32and it is arranged. Nextif it heat-treats at the temperature of not less than 300 ** with the temperature which high-melting point solder fusesthe rebonding of the semiconductor chip 31 will be carried out on the circuit board 32 via the main part 29 of a projection electrode by solidifyingafter the main part 29 of a projection electrode fuses. In this waythe reuse of the semiconductor chip 31 removed once can be carried out.

[0020]By the wayin the above-mentioned examplesince the pillar-shaped projection electrode upper layer 30 is formed on the pillar-shaped main part 29 of a projection electrode and the whole shape is made pillar-shaped as shown in drawing 1 (B) and (C)as compared with the case where it is shown in drawing 9it has the following advantages. That isas compared with the case where the projection electrode 9 of mushroom shape as shown in drawing 9 (C) is formedonly the part equivalent to the portion of the umbrella of a mushroom can make the occupation area of a projection electrode smalland the pitch of a projection electrode can be made small by extension. As shown in drawing 9 (D)in heat-treating after plating treatment and forming the almost spherical projection electrode 9aAlthough it is easy to produce dispersion in the height of the projection electrode 9aif the projection electrodes 29 and 30 are formed only by plating treatmentit can be hard to produce dispersion in the height like the above-mentioned example.

[0021]Howeverthe shape of a projection electrode is not limited to the above-mentioned example. For exampleif it heat-treats at the temperature of about 200-290 ** with the temperature which the projection electrode upper layer 30 fusesand the main part 29 of a projection electrode does not fuse in the state which shows in drawing 1 (C)By only the projection electrode upper layer's (low melting point solder's) 30 fusingbeing round with surface tensionwhile this fused low melting point solder spreads on the whole surface of the main part 29 of a projection electrodeand solidifying in this stateWhile the projection electrode surface layer 30a is formed in the whole surface of the main part 29 of a projection electrodeit may be made for the whole shape to become almost spherical like the 2nd example shown in drawing 3.

[0022]Like the 3rd example shown in drawing 4 by heat-treating at the temperature of not less than 300 ** with the temperature which high-melting point solder fuses in the state which showsfor example in drawing 1 (C)while making almost spherical the main part 29a of a projection electrodeThe whole surface of this main part 29a of a projection electrode is made to cover the projection electrode surface layer 30aand it may be made for the whole shape to become almost spherical.
[0023]Nextdrawing 5 (A) - (C) shows each formation process of the projection electrode in the 4th example of this inventionrespectively. Thenreferring to these figures in orderit combines with that formation method and the structure of the projection electrode of this example is explained. Firstas shown in drawing 5 (A)the same thing as what is shown in drawing 1 (A) is prepared. Thereforein drawing 5 (A)the same numerals are given to drawing 1 (A) and identical partsand the explanation is omitted.
[0024]Nextas shown in drawing 5 (B)the layer 41 for substrate metal stratification is formed in the whole upper surface. Nextthe plating resist layer 42 is formed in the portion except the portion corresponding to the connection pad 23 of the upper surface of the layer 41 for substrate metal stratification. Thereforethe opening 43 is formed in the plating resist layer 42 in the portion corresponding to the connection pad 23 in this state. In this casethe thickness of the plating resist layer 42 is comparatively thin with about 30 micrometers. Nextby performing electrolytic plating of solder by making the layer 41 for substrate metal stratification into a plating current wayThe main part 44 of a projection electrode which becomes the upper surface of the layer 41 for substrate metal stratification in the opening 43 of the plating resist layer 42 from high-melting point solder is formedand the projection electrode upper layer 45 which consists of low melting point solder subsequently to the upper surface of the main part 44 of a projection electrode and the upper surface of the plating resist layer 42 of the circumference is formed. In this casesince low melting point solder plating is deposited isotropicthe umbrella-like projection electrode upper layer 45 will be formed on the pillar-shaped main part 44 of a projection electrode. Nextthe plating resist layer 42 is exfoliated. Nextif the unnecessary portion of the layer 41 for substrate metal stratification is etched and removed by using the projection electrode upper layer 45 and the main part 44 of a projection electrode as a maskas shown in drawing 5 (C)the substrate metal layer 41a will be formed under the main part 44 of a projection electrode. In this waythe

projection electrode in this example is formed.
[0025]If it heat-treats at the temperature of about 200-290 ** with the temperature which the projection electrode upper layer 45 fusesand the main part 44 of a projection electrode does not fuse in the state which shows in drawing 5 (C)By only the projection electrode upper layer's (low melting point solder's) 45 fusingbeing round with surface tensionwhile this fused low melting point solder spreads on the whole surface of the main part 44 of a projection electrodeand solidifying in this stateWhile the projection electrode surface layer 45a is formed in the whole surface of the main part 44 of a projection electrodeit may be made for the whole shape to become almost spherical like the 5th example shown in drawing 6. In this caselike the 6th example shown in drawing 7 by heat-treating at the temperature which high-melting point solder fuseswhile making almost hemispherical the main part 44a of a projection electrodeThe whole surface of this main part 44a of a projection electrode is made to cover the projection electrode surface layer 45aand it may be made for the whole shape to become almost spherical.
[0026]It is good also as a structure which made the upper part of the main part 44 of a projection electrode the shape of an umbrellaand formed the umbrella-like projection electrode surface layer 45 in the upper surface like the 7th example shown in drawing 8. In each example shown in drawing 1drawing 3drawing 5drawing 6and drawing 8respectivelyThe main parts 29 and 44 of a projection electrode are formed by the electrolytic plating of metalsuch as money (Au) whose melting point is bigger than soldercopper (Cu)and nickel (nickel)and it may be made to form the projection electrode upper layers (surface layer) 30 and 45 (30a45a) by the electrolytic plating of the solder whose melting point is lower than it. When it does in this way and a rebonding (repair) is carried outa rebonding (repair) will be carried out by using the solder which consists of a part of projection electrode upper layers (surface layer) 30 and 45 (30a45a) which remain on the surface of the main parts 29 and 44 of a projection electrode. The electronic parts which have a projection electrode may be other electronic parts of not only a semiconductor chip but the 1st circuit board 32 grade shownfor example in drawing 2.
[0027]
[Effect of the Invention]As explained abovewhen carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of low melting point solder formed in itin an invention given in claims 16and 10the original form will be maintained as it iswithout the main part of a projection electrode which consists of

high-melting point solder of electronic parts fusing.
Thereforethe fall of bonding strength and short circuit which the shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easilyand originate in collapse of the shape of a projection electrode by extension can be prevented from generating.
In an invention given in claims 47and 11when carrying out bonding of the 1st substrate on the 2nd substrate via the projection electrode which consists of solder formed in itthe original form will be maintained as it iswithout the main part of a projection electrode which consists of metal whose melting point is higher than the solder of electronic parts fusing.
Thereforethe fall of bonding strength and short circuit which the shape as the whole projection electrode of the electronic parts which consist of semiconductor chips etc. cannot collapse easilyand originate in collapse of the shape of a projection electrode by extension can be prevented from generating.
In an invention given in claims 16and 13. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the low melting point solderit is heat-treating at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of low melting point solder first fusesand consists of high-melting point solder does not fuse.
Thereforethough the main part of a projection electrode which consists of high-melting point solder does not fuse but solder remains on a substrateit is a part of projection electrode surface layer which consists of low melting point soldertherefore solder can make it possible not to remain easily on a substrate.
And since the main part of a projection electrode which consists of high-melting point solder of the removed electronic parts is maintaining the original form as it isthe reuse of the electronic parts which can carry out a rebonding on a substrate via this main part of a projection electrodetherefore consist of a previous semiconductor chip etc. can be carried out. In an invention given in claims 47and 14. When electronic parts redo the bonding of that by which bonding was carried out on the substrate via the projection electrode surface layer which consists of the solderit is heat-treating at the temperature which the main part of a projection electrode which the projection electrode surface layer which consists of solder first fusesand consists of metal whose melting point is higher than solder does not fuse.

Thereforethough the main part of a projection electrode which consists of metal whose melting point is higher than solder does not fuse but solder remains on a substrateit is a part of projection electrode surface layer which consists of soldertherefore solder can make it possible not to remain easily on a substrate.
And since the main part of a projection electrode which consists of metal whose melting point is higher than the solder of the removed electronic parts is maintaining the original form as it isThe reuse of the electronic parts which can carry out a rebonding on a substrate via the projection electrode surface layer which remains on the surface of this main part of a projection electrodetherefore consist of a previous semiconductor chip etc. can be carried out.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1](A) - (C) is a sectional view showing each formation process of the projection electrode in the 1st example of this inventionrespectively.
[Drawing 2]The figure shown in order to explain an example of the bonding of this invention.
[Drawing 3]The sectional view shown in order to explain the projection electrode in the 2nd example of this invention.
[Drawing 4]The sectional view shown in order to explain the projection electrode in the 3rd example of this invention.
[Drawing 5](A) - (C) is a sectional view showing each formation process of the projection electrode in the 4th example of this inventionrespectively.
[Drawing 6]The sectional view shown in order to explain the projection electrode in the 5th example of this invention.
[Drawing 7]The sectional view shown in order to explain the projection electrode in the 6th example of this invention.
[Drawing 8]The sectional view shown in order to explain the projection electrode in the 7th example of this invention.
[Drawing 9](A) - (D) is a sectional view showing each formation process of the conventional projection electroderespectively.
[Drawing 10]The figure shown in order to explain an example of the conventional bonding.
[Description of Notations]
21 Silicon substrate

23 Connection pad
29 The main part of a projection electrode
30 Projection electrode upper layer
30a Projection electrode surface layer